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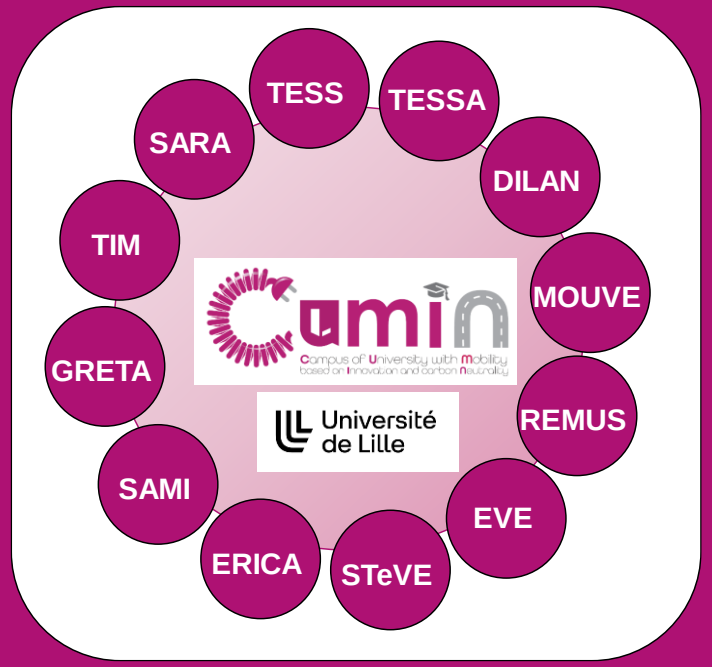

CUMIN – TESSA & MOUVE

Study of the Impact of User Charging Habits on EV Battery Aging

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Outline

1. Context and objective of the thesis
2. Vehicle and battery model
3. Impact of user charging habits on EV Batterie aging
4. Conclusion

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1. Context and objective of the thesis

Positioning of the Thesis

CUMIN: Campus of **U**niversity with **M**obility based on **I**nnovation and carbon **N**eutral

TESSA: Techno-**E**conomical **S**tudy of **S**econd life batteries for **A**ffordable e-mobility campus → Battery aging

MOUVE: MObility and **U**se of electric **VE**hicles based on dedicated charging infrastructure → User charging habits

Collaborating laboratories:

Human and social sciences

Modeling and control of electrical systems

Characterization of energy storage component

Electric vehicle charging

Thèse de A. Ndiaye

Thesis Objective

Objective: Study the impact of electric vehicle user's charging habits on battery aging.

Battery characterization

Model of Vehicle
Model of charging station

User's scenarios

Charging guideline

Studied vehicles:

Nissan Leaf 2018

Renault Zoe 2018

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2. Vehicle and battery model

Nissan Leaf modelling

❑ Traction model

❖ CUMIN program

Nissan Leaf 2018

Battery Modules (x24)

8 modules acquired for characterization

Instrumented to acquire data (SoC, battery current, ...) → Traction model

❑ Chargers

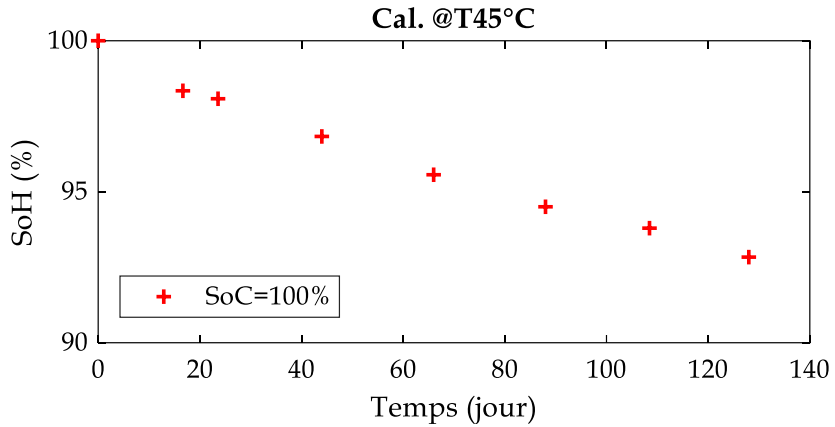
EV-box Charger

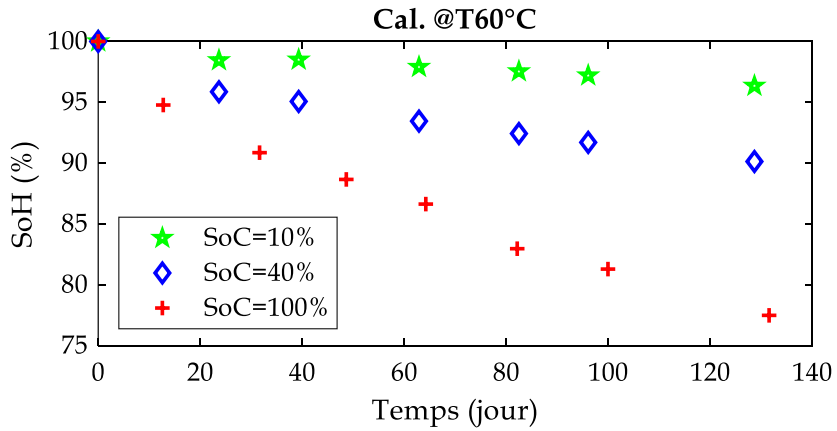
→ Recording charges

→ Modeling the charger

❑ Battery ageing

High SoC/high T accelerate ageing





→ Battery aging model

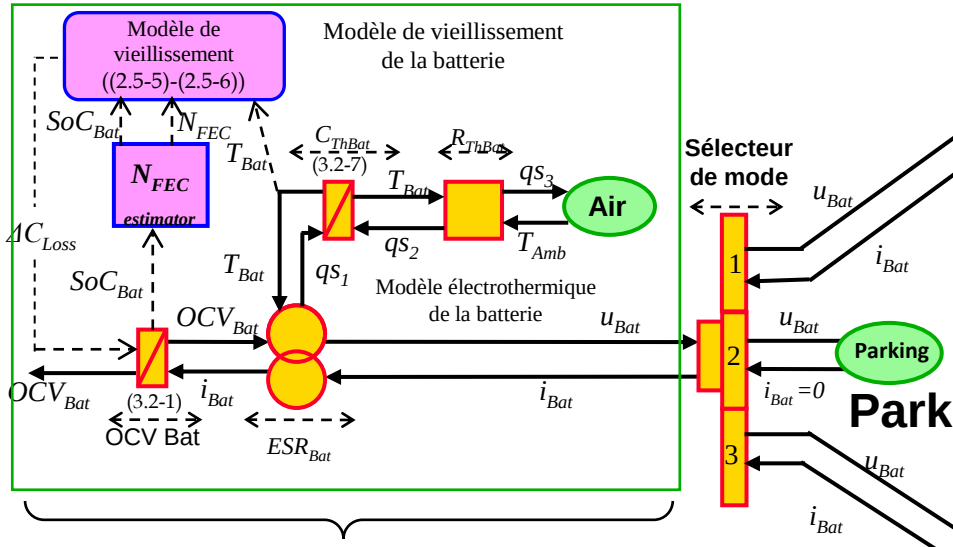
Model organization of the vehicle

Using the Energetic Macroscopic Representation formalism

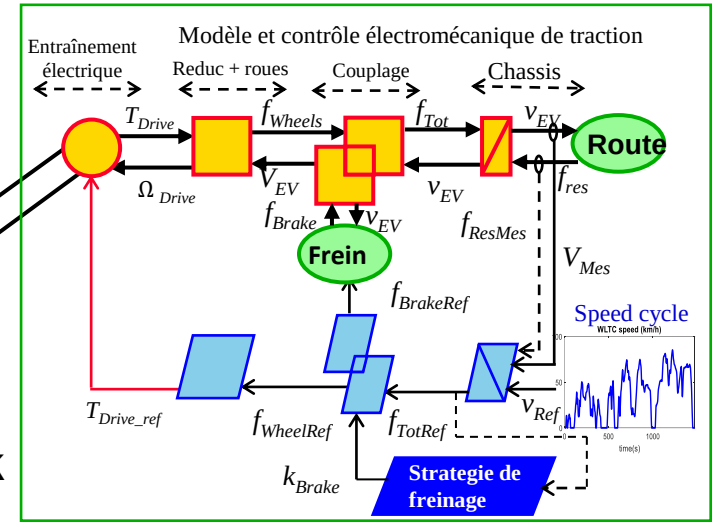
4 subsystems to model: battery, traction, charger, parking

LG Chem
(Renault Zoe)

Envison AESC
(Nissan Leaf)



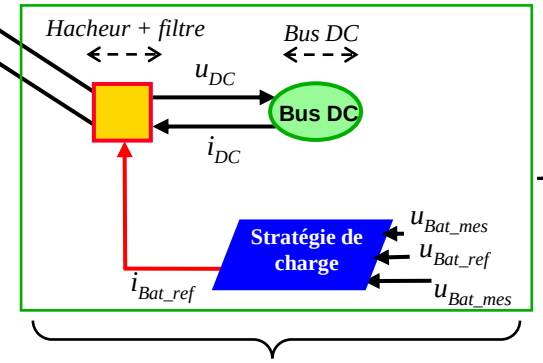
Battery



Traction

Renault Zoe
2018

Nissan Leaf
2018



Charger

Charger EV-box

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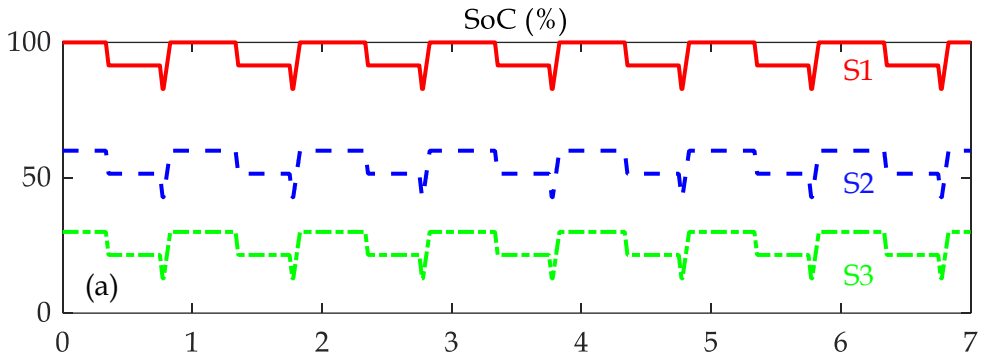
3. Impact of user charging habits on EV Batterie aging

Study of the impact of charging habits

Charging scenarios

Speed cycle: WLTC

S1, S2, S3 → **Daily charge**



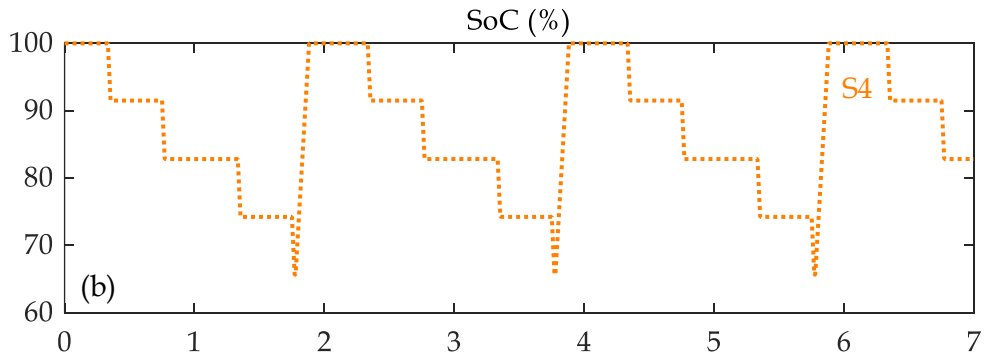
Initial SoC

S1 : 100 %

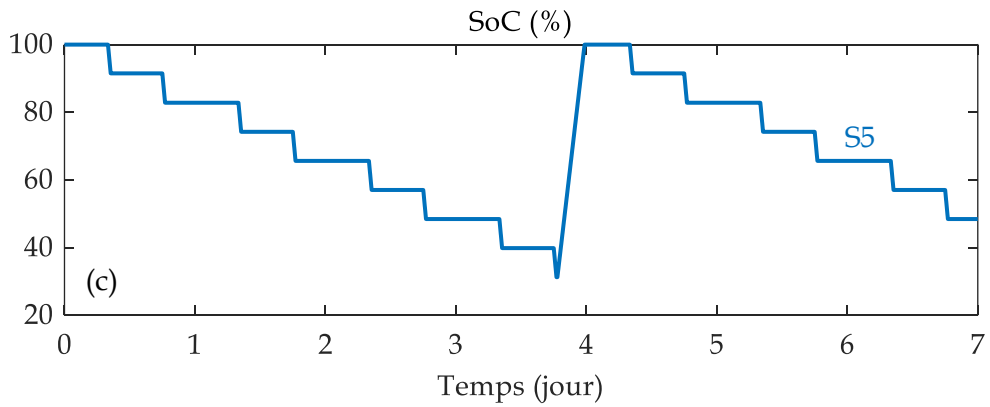
S2 : 60 %

S3 : 40 %

S4 → **Charge every 2 days**



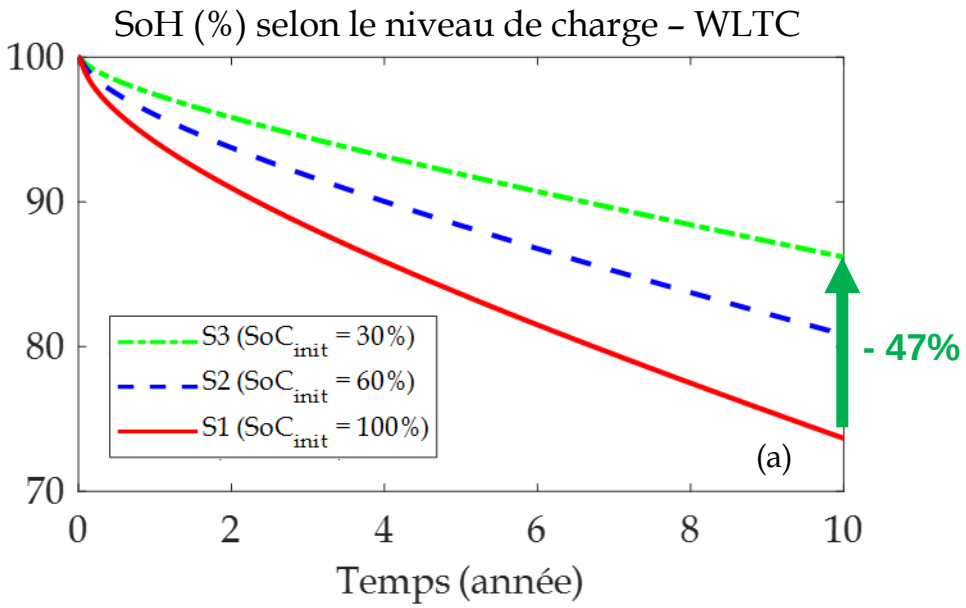
S5 → **Charge every 4 days**



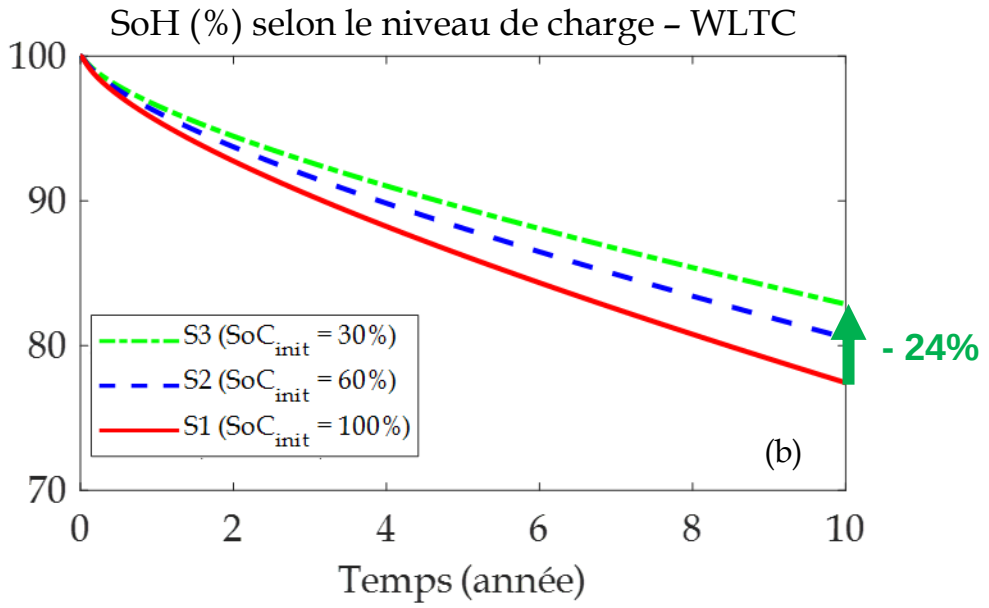
Study of the impact of charging habits

Comparison of daily charging scenarios over 10 years

Speed cycle: WLTC3



Up to - 47% degradation

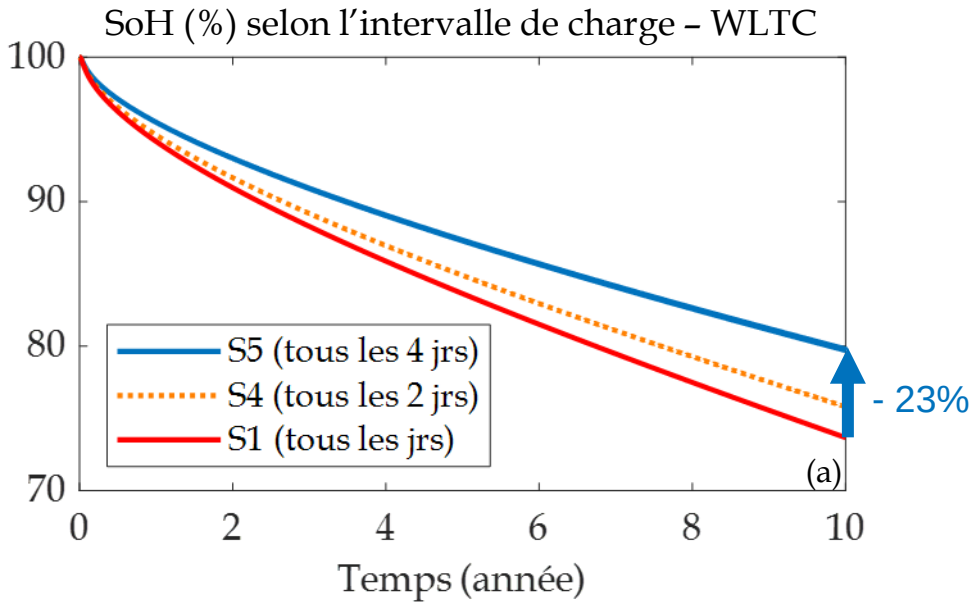


Up to - 24% degradation

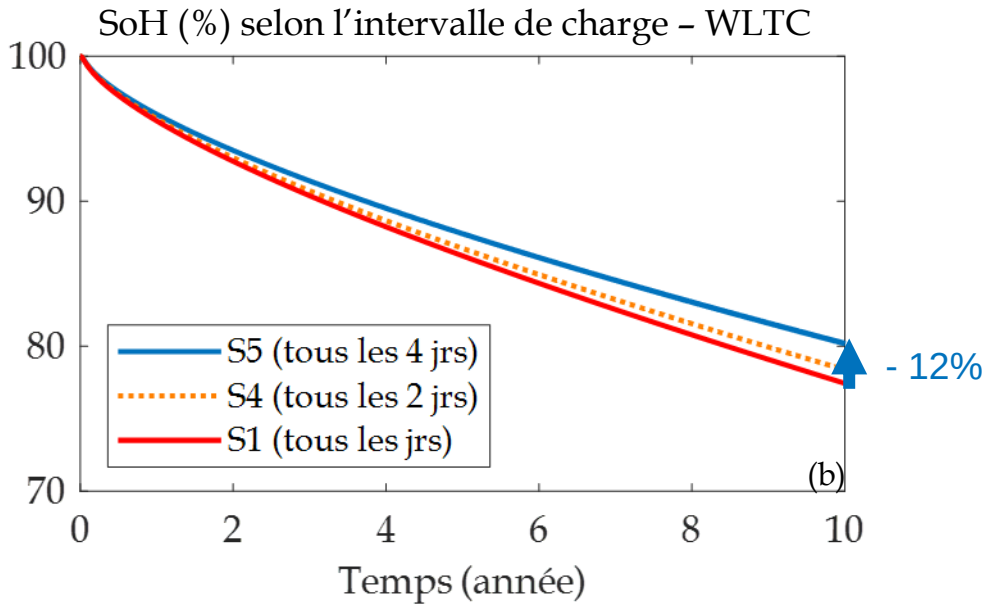
➡ Lower SoC helps to extend the battery's lifespan

Study of the impact of charging habits

Comparison of scenarios with various charging intervals over 10 years Speed cycle: WLTC3



Up to - 23% degradation



Up to - 12% degradation

➡ Spacing out recharges helps reduce battery aging

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4. Conclusion

Conclusion

✓ **Modeling:**

1. Vehicle and battery model and EMR
2. Experimental characterization of AESC cells
3. Aging tests results

✓ **Practical recommendation:** Adapt charging habits to reduce battery degradation

1. Reduce the average State of Charge (SoC)

   ➡ **Do not fully charge for long rest time (e.g. vacation)**

2. Space out recharges

   ➡ **Do not charge every day**

Acknowledgments

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Thank you for your attention !

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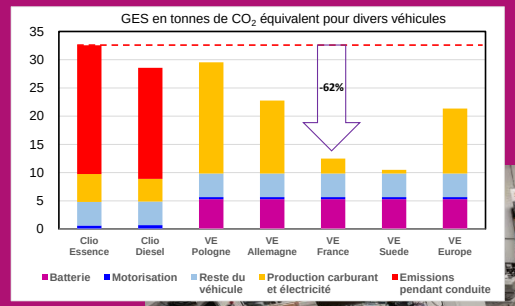

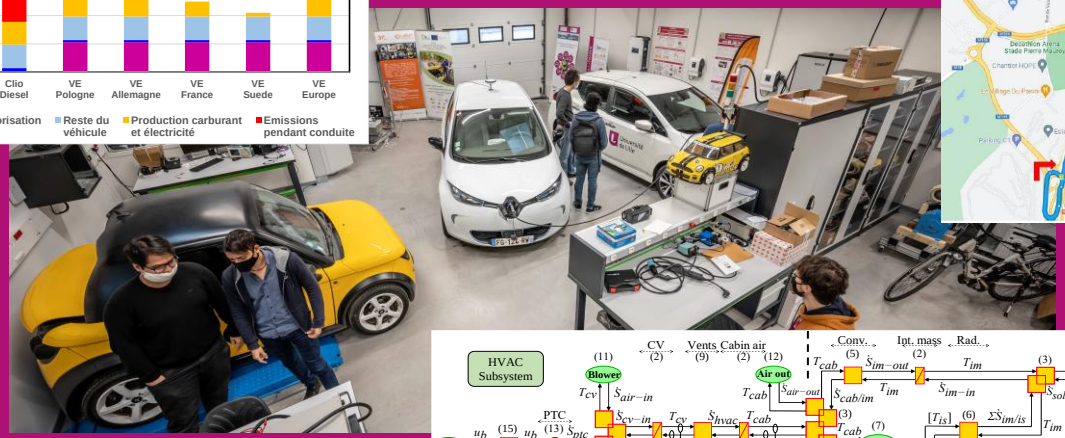

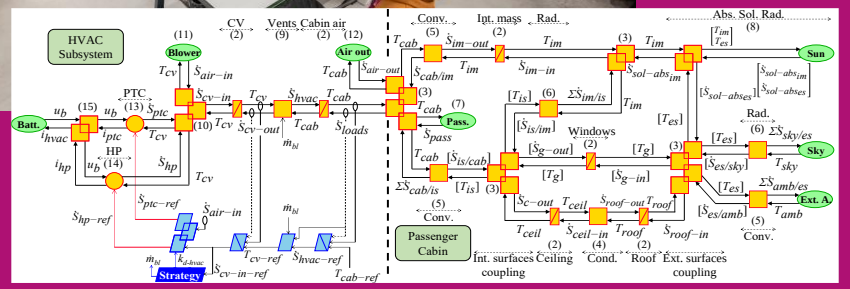

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